FIFTY YEARS OF POMOLOGY

THE SCIENCE OF FRUIT CULTURE 1916-1966

CANADA AGRICULTURE
RESEARCH STATION
SUMMERLAND, B.C.

serving agriculture

Even a star does not exist in isolation, it is part of a galaxy. So the Summerland Research Station is part of the galaxy of establishments of the Research Branch, Canada Department of Agriculture, serving the needs of agriculture in all parts of Canada. Each has a distinct and peculiar part to play in the total research program. Each gives emphasis to problems in its own territory, but all combine to provide a continually replenished reservoir of new information that can be drawn on by farmers in all parts of Canada.

In the present brochure emphasis is given to the pomology work that has been done at Summerland during the past fifty years. It is a success story, not only success in research, but success in having the research results accepted and used by the people for whom it is done. The results have had application far beyond the confines of this one valley. Similarly, work done at other units in the Department, at Kentville, N.S., St. Jean, P.Q. and Ottawa, Vineland and Harrow, Ont. has contributed to the fund of knowledge that has been applied here.

And the pomologists will be the first to admit that they cannot work successfully in isolation. Within the Station and beyond there is interdisciplinary cooperation. Plant pathologists, entomologists, plant nutritionists, and engineers, just to mention a few, have all had a hand to play in the progress that has been made.

The results of this teamwork among research officers of different disciplines, among Departmental establishments across Canada, among Federal, Provincial, and University officials, and finally between these groups and the producers is fully exemplified in the story that is unfolded in this brochure. It is this kind of teamwork that will keep Canadian agriculture vital and efficient.

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1. *Lambert Compact cherry was produced at Summerland by irradiation.*

2. *Pomology and Fruit Products Sections are housed in Horticulture Building; latter's original structure was built in 1921 (see sketch next page).*

3. *George Ryman, Station foreman, served as orchard foreman, 1949-52.*

4. *G. M. Weiss, Pomologist, 1956-61, recording terminal growth of spur-type Delicious trees in the nursery.*

5. *Pomology Physiology Laboratory.*

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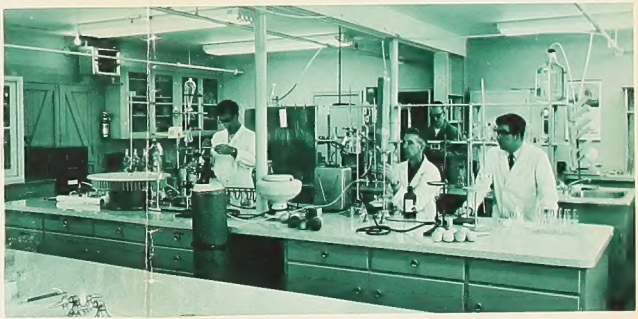

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FIFTY YEARS OF POMOLOGY

the early years

Experimental work on fruit crops began in 1916 at the Summerland Research Station, two years after the Station opened. The plantings consisted of the following apples: McIntosh, Delicious, Newton, Yellow Transparent, Grimes Golden and Rome Beauty, with fillers of Wagener, Duchess, and Jonathan. Despite shortages of water and probably some deficiencies in minor elements, these early plantings grew fast and significant yields were being harvested from them in 1922.

The orchards were set out by the first Superintendent, R. H. Helmer, and as the Station progressed, the late A. J. Mann was appointed as Horticulturist in January, 1921. From 1922 to 1933 he was in charge of the tobacco project but in 1933 returned to fruit work in which he continued until his retirement in 1955. The late R. C. Palmer, appointed in July 1921, took over the Pomology projects, and in 1928, was joined by J. E. Britton to investigate problems in stone fruit culture. F. N. Hewetson was in charge of rootstock work from 1933 to 1936. Present members of the research staff include Dr. D. V. Fisher, Section Head, appointed in 1933; Dr. S. W. Porritt, 1949; Mr. K. O. Lapins, 1950, Dr. M. Meheriuk, 1965, and Dr. N. E. Looney, who joined the staff in 1966. Mr. G. M. Weiss worked in Pomology from 1956 to 1961, and Dr. D. R. Heinicke from 1962 to 1965.

Two men who made important contributions to the pomology research program were Harold Smith and D. J. Strachan, orchard foremen from 1925-1940 and 1940-1949 respectively.

The first horticultural building, a rough, 1½-storey structure with a concrete basement containing common storage cellars, was built in 1921. Later, the present fruit processing laboratory was added and, in 1930, the pomology part of the building was expanded to include five basement cold storage rooms. In 1948, the original part of the building was torn down to the ground floor and a new and larger 2-storey structure comprising offices and laboratories constructed. More cold storage rooms were added at a later date. The present building houses a Pomology staff of 12 full-time employees.

In the early years, most work centered on cultural problems relating to fertilizers and cover crops, pollination, thinning, harvesting and pruning. Orchard performance was systematically recorded,

and as a result, in 1936, a comprehensive bulletin was published dealing with apple thinning treatments.

The problem of water core in the Jonathan apple variety, in particular, was investigated by the late Dr. Palmer. He developed the skin color chart as an aid in harvesting Jonathan at the correct stage of maturity to avoid water core. He also published two scientific papers on Jonathan breakdown and its control. This work greatly reduced losses from breakdown in the Jonathan variety, then widely grown.

A block of peaches and apricots was planted in 1925 to compare methods of soil culture and pruning. The results were published in 1937 in a Departmental bulletin by J. E. Britton: "Soil maintenance and pruning methods for peaches and apricots."

The Rochester peach was introduced to the B.C. industry in 1926, followed by the Vineland Station varieties, Vedette, Veteran, and Valiant in the 1930's, marking a new era in peach production.

The Summerland Red sport of McIntosh was introduced in 1929 and the Turner Red Delicious from Salmon Arm soon after.

Dr. Palmer's work on objective maturity tests for apples and especially pears provided basic information in the proper handling of these fruits. His findings on the correct picking dates for pears are still basically those used by the industry.

Although not the work of the Pomology Section, mention should be made of the important discovery in 1935 by Dr. H. R. McLarty of the need for boron to cure the nutritional deficiency causing corky core, drought spot and die-back which threatened to wipe out orchards in many interior areas. This was followed later by the identification and cure of deficiency disorders caused by three other minor elements, namely manganese, zinc and magnesium.


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1. *D. V. Fisher, Pomology Section Head, examining spring growth in new apple variety test plots.*

2. *K. O. Lapins examines 3-year-old McIntosh apple trees... compactness induced by irradiation (left) lowers production costs.*

3. *R. H. Helmer, Superintendent, 1914-23, set out Station's first orchards.*

4. *Late R. C. Palmer, Superintendent, 1932-53, first took over Pomology projects in 1921.*

important recent and current projects

ROOTSTOCKS FOR CONTROLLING TREE SIZE

Control of tree size has become an important factor in lowering costs of fruit production. The Summerland Research Station has been experimenting since 1929 on the clonal propagation of size-controlling rootstocks for apples, and these rootstocks have been used in this area in commercial plantings since the early 1940's.

Experimental plantings were established on the Research Station in 1933, 1934, and 1938 utilizing the Malling rootstocks, M.I, M.II, M.IX, M.XII and M.XVI. These trees, with the exception of the M.IX's planted in 1938 have been removed. These are now among the oldest trees on M.IX in North America and are a point of interest to all visiting research workers and growers. A bulletin on "Apple frameworks and rootstocks in B.C." was published in 1953 by Mann and Keane. Additional plantings were made on the Station in 1957, 1960 and 1966 with M.II, M.VII, and M.XXV, and M.26 and the Malling-Merton series MM. 104, MM. 106, MM. 109 and MM. 111. One of these plantings was established to study pruning methods for trees grown on size-controlling rootstocks.

There has been widespread acceptance by growers in the interior of British Columbia of clonal rootstocks for regulating tree size. Since 1960, about 80 percent of the apple trees planted in B.C. have been on these stocks. The majority of these are on the semi-standard size M.II, MM. 104 and MM. 111, followed in numbers by the semi-dwarf M.VII and M.IV and the full dwarf M.IX. The Malling-Merton stocks introduced in 1953 have gained in popularity and recently there have been extensive plantings on these stocks, especially MM. 104 and MM. 111. The bulletin "Growing apples on dwarfing rootstocks", published in 1957 by G. M. Weiss and D. V. Fisher, has proven immensely popular and is superseded by the 1966 bulletin "High density orchards for British Columbia conditions" by D. V. Fisher.

In addition to the Malling and Malling-Merton rootstocks, apple rootstocks developed by the Ottawa Research Station are also under trial. *Prunus tomentosa* is about to be given an extensive

trial as a dwarfing stock for cherry, plum, peach, and apricot, based on present favorable results as a rootstock for peach.

HARDY FRAMEWORK STOCKS

In the British Columbia interior, late fall and mid-winter freezes have in some years caused severe trunk damage to apple and other fruit trees. The severe winters of 1924-25, 1935-36, 1949-50 and 1964-65 eliminated fruit production in several marginal areas in the Northern Okanagan and adjacent valleys.

As a result of the work of the late Dr. R. C. Palmer, the double-working of tender apple varieties in the northern Okanagan began in 1926, and by 1935, approximately 29,000 trees had been double-worked, mainly to Canada Baldwin. Large-scale experimental plantings of several varieties on hardy framework stocks including Antonovka, Canada Baldwin, McIntosh, Charlamoff and Hibernal were made by A. J. Mann, in cold areas, between 1938 and 1942. After screening these and other stocks for structural strength, resistance to crown rot and survival in the 1949-50 and 1955 freezes, those framework varieties currently recommended are McIntosh, Ottawa 292, Ottawa 271, Antonovka, and Haralson. Canada Baldwin was dropped because of crown rot susceptibility. A further 9.5-acre block of Spartan top-worked to 13 hardy framework stocks was planted between 1957 and 1959 in the Coldstream area of Vernon. Temperatures in this area have dropped to as low as —33°F and hence may provide a good test for hardiness.

Following the 1955 freeze it was recommended that all scion varieties less hardy than McIntosh be worked on hardy framework stocks. These scion varieties include Delicious, Spartan, Newtown, Winesap, Golden Delicious and Rome Beauty. Losses of unframeworked trees in the December 1964 freeze further emphasized the need for hardy stems for most apple varieties.

FRUIT BREEDING

Fruit breeding has been an important project at this Station since 1924 when the late Dr. R. C. Palmer made the first apple crosses. The program was

1. *N. E. Looney tagging flower clusters on trees used in B-nine experiment.*

2. *M. Meheriuk doing a micro-titration on apple organic acids.*

3. *Starkrimson, spur-type Delicious strain, being widely planted in B.C. as a means of reducing tree size and promoting early bearing.*

4. *Hans Schmid examining apple seedlings in the greenhouse; breeding program involves annual production of 4000 apple, apricot, and sweet cherry seedlings from known parent crosses.*

greatly expanded under A. J. Mann and F. W. L. Keane and at present involves a continuing population of 10,000 apple, 2,500 apricot and 1,500 sweet cherry seedlings, as well as several thousands of grafts from irradiated scions of standard varieties. The outstanding contributions of this Station have been Spartan apple and the Van and Sam cherry; now among the major varieties being planted in British Columbia and other fruit areas.

The present program, under the direction of K. O. Lapins, deals with breeding of apples, apricots and sweet cherries. Objectives are the development of high quality, late-keeping McIntosh-type apples; hardy, split-resistant, high quality black cherries; and hardy, early, dual-purpose apricots. In all fruits, cold hardiness and compact growth habit are very important breeding objectives. The methods used include inter-varietal and interspecific cross-breeding, selfing, and mutation breeding. In cross-breeding of apples, varieties with high fruit quality are being crossed with either cold-hardy or scab-resistant selections.

PRODUCTION OF COMPACT (SPUR TYPE) STRAINS

The mutation breeding program involving ionizing irradiation applied to scions of standard varieties shows great promise and has resulted in the introduction of the Lambert Compact cherry in 1964. This introduction has met with world-wide demand. Compact strains of apples are expected to follow. Other promising radiation-induced mutants are partially-fertile Golden Delicious apple and Blenheim apricot, which set less heavily and require less thinning than the regular strains.

CERTIFIED BUDWOOD PROGRAM

The B.C. Department of Agriculture, the B.C. Fruit Growers' Association, tree fruit nurserymen, and the Summerland Research Station for a number of years have sponsored a Certified Budwood Program for producing trees virus-free and true-to-name. The first step in making this program possible was taken by K. O. Lapins in establishing leaf identification keys for main fruit varieties. He published a standard reference on the subject and instructed nursery inspectors in variety identification on the basis of vegetative characteristics on nursery trees. A full-time appointee of the B.C. Fruit Growers' Association, H. Domi, is now located at the Research Station in charge of foundation orchards and bud and scion wood distribution. About 97 percent of all fruit trees produced in B.C. are now propagated from certified budwood.

VARIETY EVALUATION

Another important function of the Pomology Section is to collect promising varieties from all parts of the world and test them under local conditions. There are 1,060 varieties and strains under trial at the present time. These strains include a total of 70 red sports of Delicious, McIntosh, Rome, Winesap, Stayman and Jonathan.

As a result of this program, important new varieties have been introduced to this industry. Examples of these are the Tydeman's Early, and red strains of standard varieties such as Harrold Red Delicious, Mosebar Red Winesap, Summerland Red McIntosh, and Cowin Red Rome. Among the compact or spur-type apple mutations, those tested and recommended

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for this industry include the Redspur, Starkrimson, Hardispur and Wellspur strains of Red Delicious, and the Starkspur, Yellowspur and Goldspur strains of Golden Delicious. Important peaches tested and recommended for planting in this area have included the three Vees, Redhaven, Triogem, Fairhaven, Redglobe and Vedoka. The latter five peach varieties are firm-fleshed with good handling characteristics. As a result of Station testing, commercial plantings of Fortuna, a California-type non-melting clingstone peach have been made. Several new hybrid grape varieties introduced and tested by the Pomology Section are undergoing extensive planting by the industry. Most promising are Seibel 9549, 9110, Foch, New York Muscat and Bath.

FRUIT THINNING

Thinning is necessary to reduce the number of fruits per tree and ensure adequate fruit size. The most effective thinning practice is designed to remove the required number of fruits from the tree early in their growth period. Thinning of apples has evolved from the laborious practice of hand removal of partially

1. *D. R. Heinicke, Pomologist, 1962-65, measuring photosynthesis on apple leaf, operation involves infrared carbon dioxide analyser in mobile laboratory (right).*

2. *J. E. Britton, Pomologist, 1928-49, testing maturity of Newtown apples by starch-iodine reaction.*

3. *Pressure testing, cutting and examining experimental lot of apples. Left to right: E. D. Edge, S. W. Porritt, D. V. Fisher.*

4. *A. J. Mann, Pomologist, 1933-55, with machine that records pressure necessary to break union between scion and rootstock.*

5. *F. N. Hewetson, now Pomology Professor, University of Pennsylvania, was in charge of Summerland Station's rootstock work from 1933-36.*

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grown fruits to present chemical and mechanical methods. Chemical thinning for apples has been a well established practice for more than 15 years, involving the use of three chemicals, and present recommendations represent the culmination of a long program of research at the Summerland Station. If weather is favorable it is recommended that apples be thinned with a dinitro spray during full bloom, which may or may not be followed later by a hormone spray of Sevin or Amid-Thin. When damp weather at blossom time makes the use of dinitros unsafe, it has been shown that thinning still can be performed satisfactorily at 14 to 21 days from bloom using Sevin or Amid-Thin.

An important discovery by the Pomology Section has been that all thinning sprays may be applied with equal effectiveness using either dilute sprays of 500 gallons per acre or with concentrate sprayers using as little as one-tenth this amount of water to apply the same amount of chemical per tree.

With stone fruits, the idea of hand-thinning of blossoms was pioneered at the Station about 16 years ago and is gaining increasing acceptance in areas reasonably free of spring frosts. Growers are able to thin apricots and peaches at blossom stage when there is surplus labor, and when the tree can benefit most. Chemical sprays for thinning peaches at blossom time are also under trial but to date no chemical has proven reliable. Shaker thinning trials for peaches, started in 1964, appear promising and 1966 results are under evaluation.

No satisfactory blossom or early thinning method has been found for pears.

STOP-DROP SPRAYS

The use of stop-drop sprays, first naphthalene acetic acid and later 2,4,5 trichlorophenoxypropionic acid (2,4,5-TP), has been thoroughly tested by the Pomology Section and recommended for control of drop in McIntosh and other varieties. These sprays showed equal effectiveness applied in dilute or concentrate form, and have saved McIntosh apple growers millions of dollars in preventing loss by windfalls. When licensed for general use, the new growth regulator, B-nine, may prove the best stop-drop we have yet found.

In addition to use as a stop-drop, B-nine has many other interesting possibilities. Work started in 1964 and conducted on a large scale in 1965 and 1966 indicates that this material applied one to two weeks after full bloom, checks terminal growth, and in high concentrations reduces fruit size, improves color, delays fruit softening both on and off the tree and improves return bloom in the year after application.

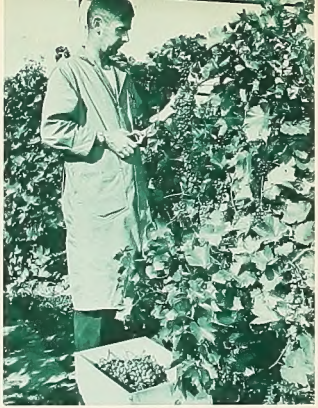
AGROMETEOROLOGY

Agrometeorology deals with the relation of moisture, temperature, and light to plant growth. Studies at Summerland of the relationship of days from full bloom to harvest have provided useful data on amount of heat and length of season required to mature different fruit crops. A detailed study on this has been published.

The next step has been to explore the effects of light, shade, and temperature on photosynthesis, the basic process in all plant life whereby carbon dioxide from the air and water from the soil are combined in the leaf under the influence of chlorophyll to form carbohydrates. Intensive studies by D. R. Heinicke showed that there are basically two light intensity zones in fruit trees, a high intensity zone with 6,000 to 11,000 ft.c. in direct sun exposure, and a low intensity zone of 400 to 1,000 ft.c. in shaded position. Even the shade of one leaf reduces light intensity from 12,000 ft.c. in direct sun to 600 ft.c. in shade. The rate of photosynthesis was four times greater in high light intensity areas than in shaded areas. Further studies of photosynthetic efficiency in terms of tree size showed that, on an acre basis, there was one third more foliage favorably exposed on dwarf than on standard-size trees.

FRUIT HARVESTING AND STORAGE

Many aspects of fruit harvesting and storage have been investigated at the Summerland Station since the program was initiated in 1919 by the late Dr. Palmer. Results of experimental work by the Pomology Section have been incorporated into basic policy and procedures of the British Columbia fruit packing and storage industry which handles some 11 million bushels of apples, pears and soft fruits annually. At present there are 58 cold and controlled atmosphere



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storages of the most modern construction in the fruit-growing area with a capacity for about 8 million bushels. A bulletin "Fruit harvesting and storage in British Columbia" by Britton and Fisher was first published in 1941 and revised in 1952.

An important part of the experimental program has been to determine and describe the optimum stage of maturity for harvesting different varieties of fruits so as to ensure high quality, long storage life and freedom from physiological disorders. Maturity indices have been continually improved as knowledge of fruit growth and physiology has increased and new techniques are developed.

Experimental work at Summerland on post-harvest chemical and physiological changes in fruit has shown that ripening proceeds at a greatly accelerated pace when a fruit is detached from the tree, unless cooling, usually to 30°F, is accomplished promptly. This applies especially to pears. Adoption by the industry of handling and storage practices based on these studies has ensured maximum storage life for pears and has enabled apples to be sold into June.

The Pomology Section has worked closely with the fruit storage industry for over 25 years, mainly to assist in improving the adequacy and application of mechanical refrigeration to ensure rapid removal of heat from fruit.

CONTROLLED ATMOSPHERE STORAGE

The program in controlled atmosphere storage was started in 1936, using the McIntosh apple. The conditions recommended for C.A. storage of Delicious, published in 1940, and later confirmed by others, are basically those recommended today. The C.A. storage work, under direction of S. W. Porritt, is an important part of the Pomology research program, and the industry has drawn heavily upon the experience and advice of Station specialists. At present, great hopes are centered on making Spartan an important late-season apple through the use of C.A. storage.

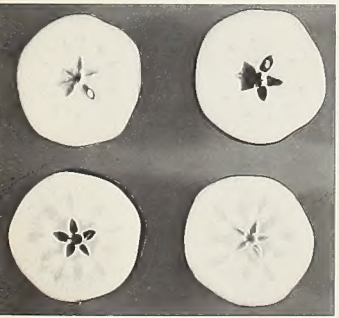
Conditions recommended for C.A. storage of McIntosh are 5% CO_2, 3% O_2 at 35°F; for Spartan 2% CO_2, and 3% O_2 at 30°F; and for Delicious and Bartlett pear 2% CO_2 with 2 to 3% O_2 at 30°F. These recommendations are used by local storages.

Lime scrubbers for C.A. storages, originally developed in Nova Scotia, have been successfully introduced in British Columbia, and are universally used in this area for maintaining correct CO_2 and O_2 levels in C.A. storages.

Present controlled-atmosphere storage capacity in the B.C. Interior is about 624,000 boxes with another 400,000 boxes cold storage capacity readily convertible to C.A. storage.

Recent experiments on the use of diphenylamine and ethoxyquin as post-harvest dips to control apple scald have provided important information on control of this disorder in fruit sold loose and not subjected to the previous control technique provided by packing fruit in oiled wrappers. Based on Pomology Section's recommendations, the use of ethoxyquin has been adopted as a standard scald control measure by the industry.

The development of an alcohol flotation separation method by S. W. Porritt and A. D. McMechan, for eliminating water-cored Delicious apples from commercial stocks prior to packing has saved the industry hundreds of thousands of dollars.



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1. *Seibel 9549 grape is Station's most promising of hybrid varieties recommended to the industry. F. M. Trussell.*

2. *Rapid cooling of Bartlett pears following harvest shows up to advantage after 12 weeks' storage. Those cooled at 30° F. in one day are free of breakdown, those delayed at 70° for 2 days or cooled slowly to 30° or 32° show heavy breakdown.*

3. *Normal (upper) and water cored (lower) Delicious apples resulting from delayed harvest, an alcohol flotation process for commercial separation of affected fruit was developed at Station.*

4. *R. G. Killick tying down new shoots on 3-year-old Delicious to promote early bearing and develop spindle bush form. Inset: H. J. Pelham, orchard foreman since 1952.*

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M. Mehcriuk, B.Sc., B.Ed., Ph.D.
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Agrometeorology, Growth Regulators

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H. C. Schmid—*Fruit Breeding*
F. M. Trussell—*Fruit Varieties, Storage, Thinning*
R. G. Killick—*Fruit Agrometeorology, Rootstocks, Frameworks*
V. Lejins—*Cold Hardiness Studies*
H. J. Pelham—*Orchard Foreman*

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